

# Negative interest rates – consequence staying in error? (empirical evidence)

František Kalouda<sup>1</sup>

<sup>1</sup> Masaryk University  
Faculty of Economics and Administration, Department of Finance  
Lipová 41a, 602 00 Brno, Czech Republic  
E-mail: kalouda@econ.muni.cz

**Abstract:** *The paper is focused to further description and analysis the selected aspects of behavior of Czech banking as a cybernetic system. The objective of the paper is to clarify the implications of central bank regulatory interventions in relations of the managing system (regulator – central bank) to managed system (controlled system – commercial banks) as relationships between operational indicator (discount rate) and regulated indicator (commercial rates). The paper draws on data published by the Czech National Bank (CNB) at <http://www.cnb.cz>. Methodology of the paper is principally based on the economic cybernetics with special focus to the time series methods and trends analysis. The usual description, literary research, comparison and analytic-synthetic methods are used here as well. The main expected results of the paper relate to the linkages between discount rate and the commercial rate (still not explored), which leads to a discussion of negative commercial rates. Conclusions of the paper partly redefine the position of the central bank in the banking system of the Czech Republic.*

**Keywords:** *banking system, cybernetics, discount rate, negative commercial rate*

**JEL codes:** *C67, E58, G21, G38*

## 1 Introduction

The aim of the paper is to clarify the implications of central bank regulatory interventions in relations of the managing system (regulator – central bank) to managed system (controlled system – commercial banks) as relationships between operational indicator (discount rate) and regulated indicator (commercial rates).

It should be noted that this paper is focused exclusively on the conditions in the banking system of the Czech Republic. This applies both to the theory and practice of managing this sphere of the financial system of the Czech Republic, as well as to the analyses and conclusions of the author of the paper. And above all - as conclusions and evidence of empirical character are formulated in the paper - the analyses and all the conclusions and evidence formulated herein are based on data relevant to the environment of the Czech Republic. Any generalizations of the results of the paper to other banking systems (or other territories) are subject to subsequent stages of research in the field.

Within the system of operational management of the monetary policy by the central bank (CNB), confidence remains in the possibility of managing capital cost in the commercial sphere (hereinafter referred to as the commercial rate) using three types of interest rates with a special focus on the regulatory potential of the discount rate (Revenda, 1999). The focus of theory on this rate is based on the assumption that this rate is usually considered to be the most important rate in capital cost management processes (Dvořák, 1999). Therefore, this paper focuses mainly on the discussion of this rate in the given context.

After all, the virtually invincible confidence of the theory of banking system management in the regulatory potential of the discount rate is not the exclusive domain of domestic theoretical authorities. Very similar or even identical positions can be found, for example, even in the context of the US banking system management theory (Mankiw, 2000).

Significant doubts concerning the legitimacy of this confidence in the ability of the CNB to manage the capital cost at the commercial rate level through the discount rate have been

previously published by Kalouda (2014a), Kalouda (2014b) and Kalouda (2014c). The above publications show that the commercial rate cannot be perfectly managed using the discount rate and thus the assumption is wrong.

However, the aforementioned existing results of research did not follow the wider context of the analyzed issue, they did not show what can result from dwelling in this error. Therefore, this paper focuses on presenting empirical evidence of the fact that the persistent efforts of the CNB to manage commercial rates through the discount rate necessarily lead to a discussion of the need for, or even the necessity of, the introduction of negative interest rates.

## **2 Methodology and Data**

The maximum allowable length of the paper makes it virtually impossible to provide a detailed presentation of all methodological procedures that led to the results presented below.

Similarly, the thematic focus of the paper, its obvious interdisciplinarity lead to the risk of an increase in the length of the paper beyond an acceptable limit.

Therefore, we will limit ourselves to the briefest overview possible of the most important topics discussed, in connection with the relevant sources.

### **Methodology**

The methodological input is of key importance for this paper. This fact is defined both by the nature of the issues studied and by the researches previously carried out in the relevant field, or by the publications of the results achieved respectively, to which this paper is very closely tied.

The methodical basis of the paper is naturally formed by the usual steps

- description,
- analysis,
- comparison, and
- synthesis.

In addition, however, the specific topic and the target focus of the paper virtually forced the application of methodological tools which have been less frequently used in the given context. These include, in particular:

- economics, applied mainly in capital cost management (discount rate), represented by Mankiw (2000), Revenda (1999), Soto (2009) and hysteresis in the economic environment (unemployment) (Němec, 2010),
- mathematical economics, here used to answer the question to what extent cybernetic models are usable for solving economic problems, represented by Allen (1971) and Bíza (2014),
- technical cybernetics, explaining the principles of automatic control in the form of feedback systems with a special focus on the existence of hysteresis-type nonlinearities represented by Balátě (2004), Fikar and Mikleš (1999), Houpis and Sheldon (2014), Kubík et al. (1982), Švarc (2003), Švarc et al. (2011) respectively,
- economic cybernetics, transforming the methodology of technical cybernetics into the environment of economic systems, as discussed by Allen (1971), Šerý (2010), Kalouda and Svítal (2009), and Kisačanin and Agarval (2001),
- financial business management in the form of applications of its access to economic cybernetics, as illustrated by Kalouda (2015) and Kalouda (2016), including elements of strategic management, with the primary use of Johnson and Scholes (1989),

- applied statistics, represented by Arlt and Arltová (2009), Arlt and Radkovský (2001), Blatná (2009), Cipra (2008), Hindls et al. (2007), Řezanková and Löster (2013), Swoboda (1977) and Šerý (2010),
- financial markets, primarily using information from Rejnuš (2014) as well as
- behavioral economics, or perhaps more precisely behavioral finance, in the form of Pompian (2006) and Shefrin (2007).

## **Data**

The paper is primarily based on freely available input data published by the CNB, see [http://www.cnb.cz/cs/financni\\_trhy/penezni\\_trh/pribor/rok\\_form.jsp](http://www.cnb.cz/cs/financni_trhy/penezni_trh/pribor/rok_form.jsp), and [http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS), to which (in order to save space) we hereby refer. These data include the time period from 31 January 2004 to 30 September 2013. The values of the discount rate and commercial rate are monitored.

The above data are essentially unusable for the given purpose in their original form. The necessary modifications are described and justified in Chapter 3. Results and Discussion.

## **Model Specification**

In this case, the modelled object is the banking system of the Czech Republic. We model the processes of managing capital cost at the level of businesses rate (commercial rate) by the CNB using the discount rate. The model of this system is the graphical representation of the dependence of the commercial rate on the discount rate.

This relatively simple model is, in principle, based on the assumption that the requirement for the linearity of the modelled system is met (Švarc et al., 2011). However, it is able to describe the expected nonlinearities that are typical for the banking system with sufficient accuracy. The relative simplicity of the model used is thus not an obstacle to its use for describing the situation and identifying the problem in order to obtain the reference characteristics of the examined system (Fikar and Míkleš, 1999).

## **3 Results and Discussion**

The dependence of the variables monitored is described primarily by the static characteristic, see Švarc (2002), Kubík et al. (1982), Balátě (2004) respectively.

In order to identify the desired dependence, it is necessary to approximate the data with a suitable approximation function. The nature of the problem suggests that it should be a linear function. The result obtained using the standard SW support (MS EXCEL) is shown in Figure 1.

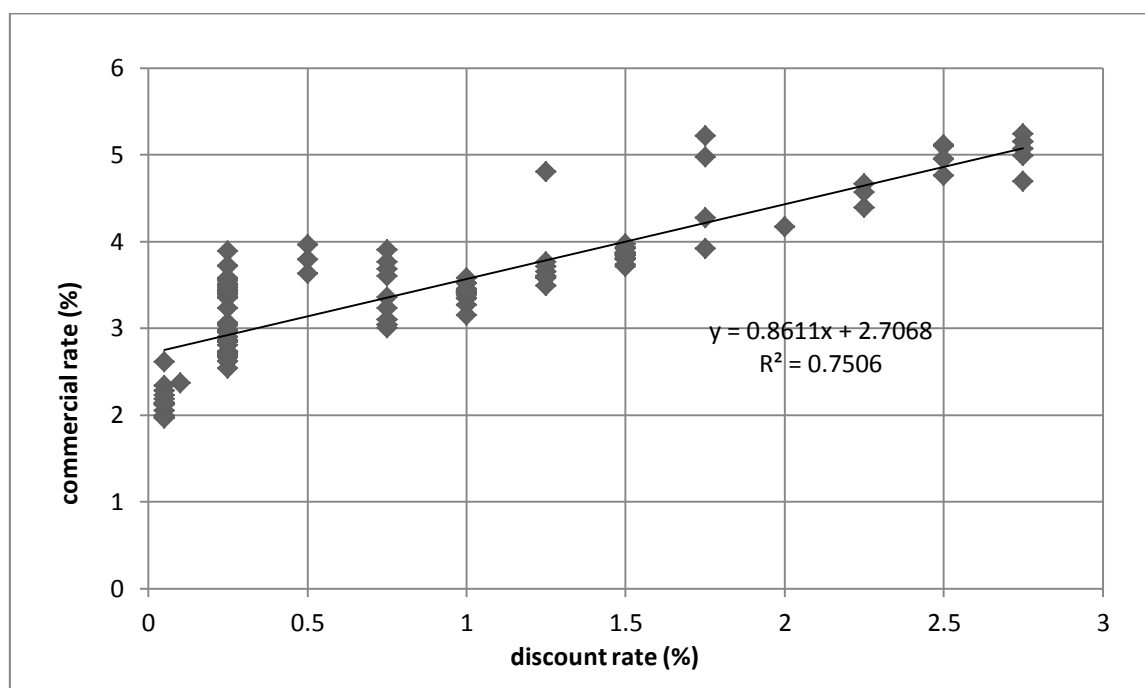
Data in Figure 1 suggest that, in terms of this concept, the banking system of the Czech Republic could be considered as a linear system only with obvious reservations.

It is a positive finding, however, that the core data set tend to cluster, which will be used immediately. Previous results (Kalouda, 2014a, Kalouda 2014b, Kalouda, 2014c) lead more or less to the clear conclusion that the behavior of the banking system of the Czech Republic is different in the case of an increasing discount rate and it is different when the discount rate is decreasing.

In addition, it will be necessary to also respect the second condition for the specific construction of the static characteristics, which is the requirement for the use of stabilized data, see, for example, Švarc (2002).

Both of these lead to the requirement to filter the data of the core data set so that they meet both conditions. The result will be two isolated approximate static characteristics, one for the increasing of the discount rate and the other for the decrease in the discount rate.

**Figure 1** Static characteristics of the core data set



Source: Prepared by the author using data from ARAD - Time series system - CNB. [on-line] Available at: <[http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS)> [Accessed on 26/11/2013].

Consequently, the complex static characteristics will be constructed from the approximated data. These will be static characteristics depicting the dependence of the commercial rate on the discount rate for both increase as well as decrease in the discount rate.

In the last step, we will proceed to the approximation of the dependencies identified by straight-line sections in the stylized form of the resulting static characteristics. They will be further used for a model experiment with multiple cycles of increase and decrease of discount rates. The aim is to prove the influence of hysteresis of the banking system of the Czech Republic on the concept of negative interest rates.

### Primary data filtering

The purpose of filtering the input core data set is primarily to

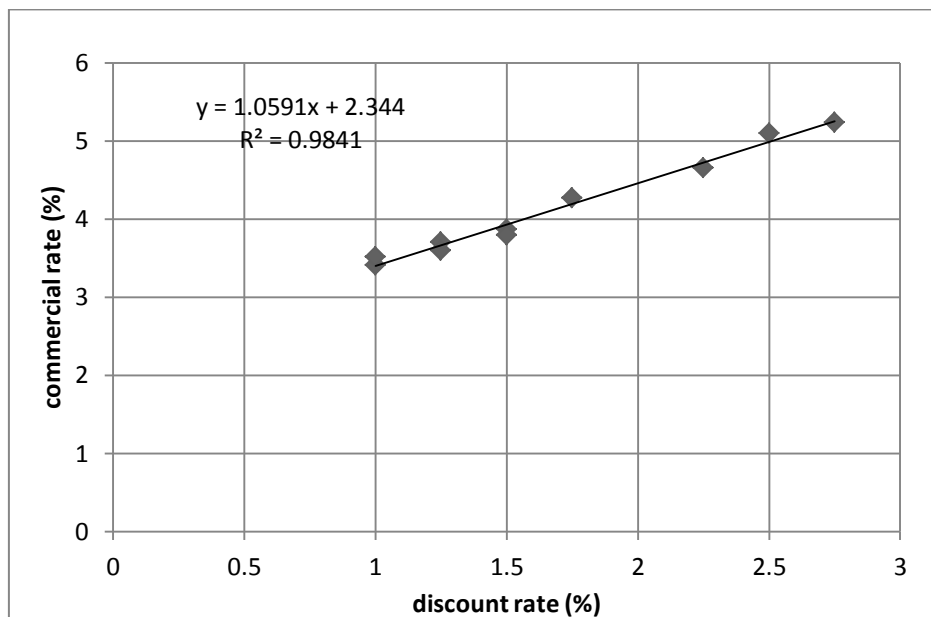
- split the data into two subsets (for the increase and decrease of the discount rate), as well as to
- stabilize data by considering only steady-state data.

Dividing data by discount rate growth or decrease is a smooth and unambiguous step. The acquisition of stabilized data is less clear, however, using the preliminary results (Šerý (2010), Kalouda (2014a), Kalouda (2014b), Kalouda (2014c) and mainly Kalouda (2016) together with Artl and Radkovský (2001)) we are concluding that two months are sufficient for the stabilization of the commercial rate.

The results of these modifications are captured in Figure 2 and Figure 3.

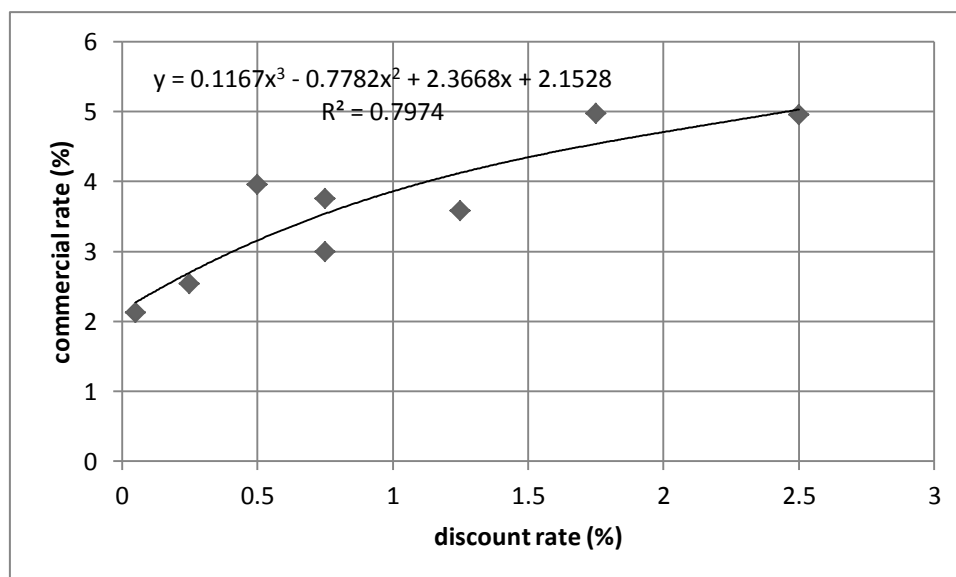
It is apparent from Figure 3 that it is impossible to obtain the perfect linearization of the static characteristic for the discount rate decrease. This leads to the previously deduced hysteresis-type non-linearity which is characteristic for the banking system of the Czech Republic.

**Figure 2** Static characteristics – increase in the discount rate (stabilized data)



Source: Prepared by the author using data from ARAD-Time series system-CNB. [on-line] Available at: <[http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS)> [Accessed on 26/11/2013]

**Figure 3** Static characteristics – decrease in the discount rate (stabilized data)

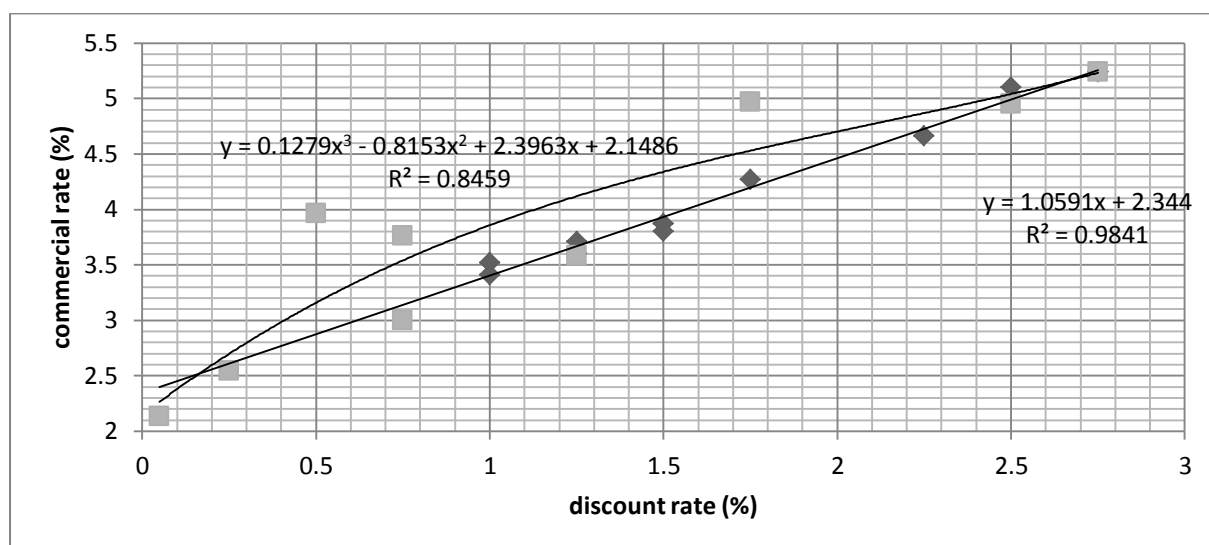


Source: Prepared by the author using data from ARAD-Time series system-CNB. [on-line] Available at: <[http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS)> [Accessed on 26/11/2013].

### Complex static characteristic

In this case, we also chose a graph to present the results obtained. The reason is simple – an attempt not to overburden the paper with an excess of numerical data (all data can be naturally provided for review by the author of the paper). The result is captured in Figure 4.

**Figure 4** Complex static characteristic



Source: Prepared by the author using data from ARAD-Time series system-CNB. [on-line] Available at: <[http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS)> [Accessed on 26/11/2013].

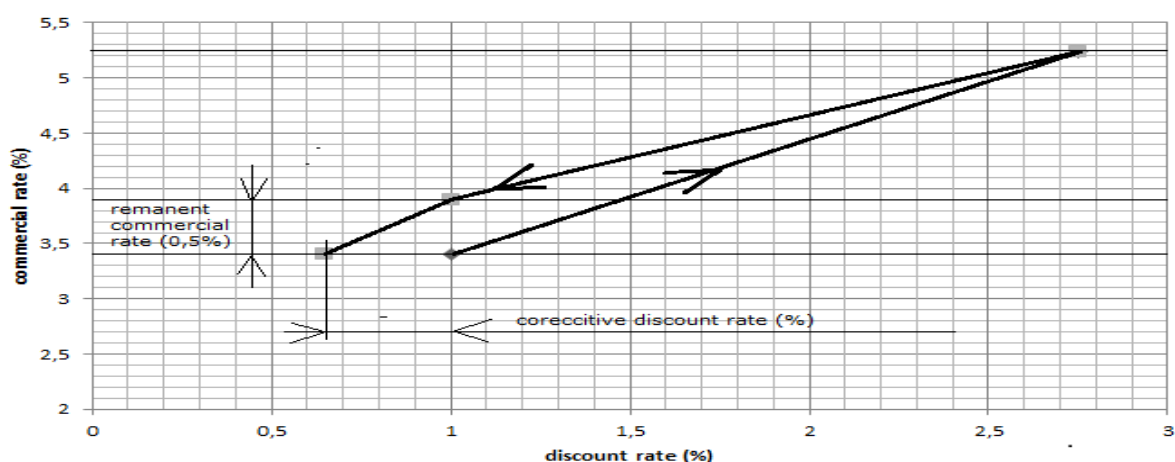
### Approximated static characteristic

The approximated static characteristic (see Figure 5) represents the idealized shape of the Figure 4. The decisive (accurate) data are:

- "start" values of the discount rate and the commercial rate [1,00%; 3,40%]
- maximum values of the discount rate and the commercial rate [2,75%; 5,24%]
- coordinates of the remanent commercial rate [1,00%; 3,90%]
- coordinates of the corecitive discount rate [0,65%; 3,40%]

The approximated static characteristic is created from the input data according to Figure 4, i.e. for the basic (first) cycle increase and the subsequent decrease in the discount rate.

**Figure 5** Approximated static characteristic (basic increase-decrease cycle)



Source: Prepared by the author using data from ARAD - Time series system - CNB. [on-line] Available at: <[http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS)> [Accessed on 26/11/2013].

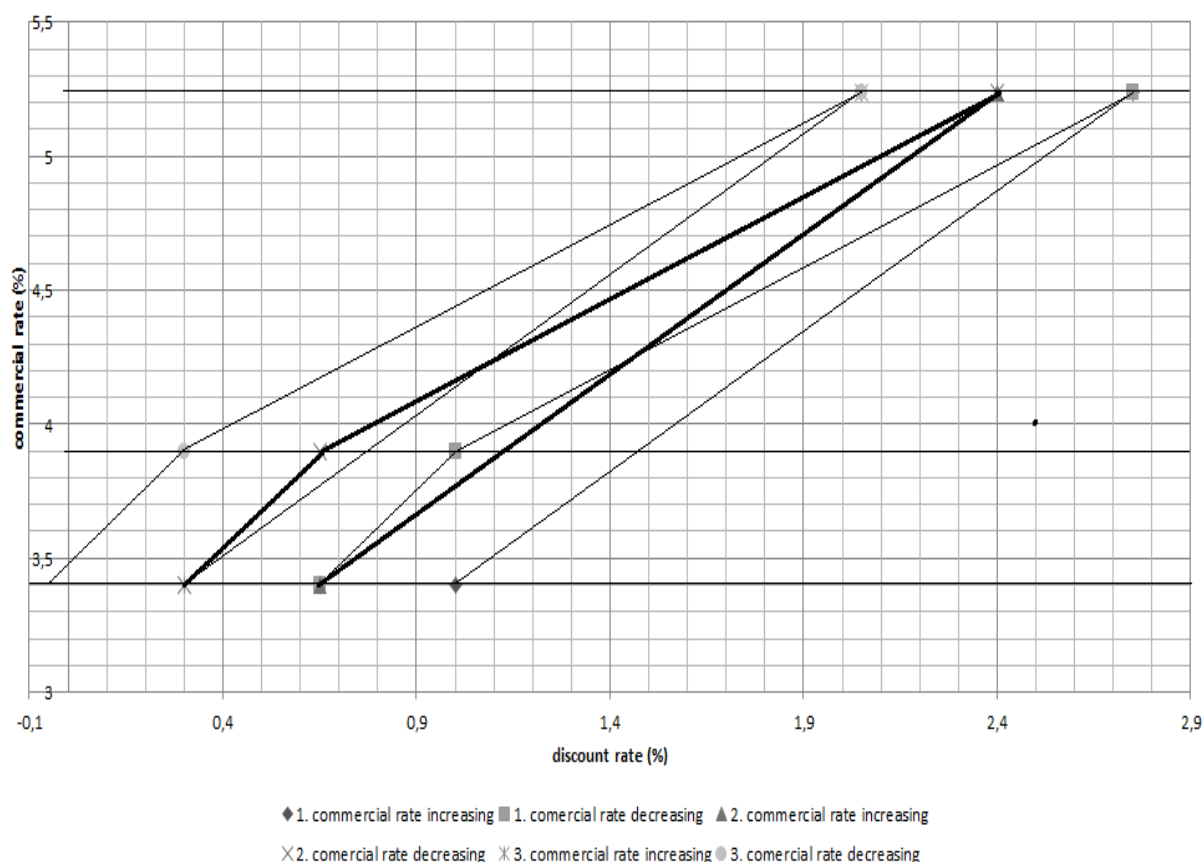
### Model experiment (repeated discount rate increase-decrease cycles)

The repeated cycles immediately follow each other, i.e. they always start where the previous cycle ended.

The first cycle ended with a decrease in the discount rate to its original value of 1,00%. The corresponding value of the commercial rate, however, was not the original 3,40% - it reached a value higher by the remanent commercial rate (0,50%), i.e. 3,90%. The commercial rate will reach the original value of 3,40% only if the commercial rate drops from 1,00% to 0,65%. This represents a decrease in the discount rate by the value of a corecctive discount rate of 0.35% (see Figure 5).

These data are deduced from the complex static characteristic (see Figure 4).

**Figure 6** Resulting static characteristic



Source: Prepared by the author using data from ARAD - Time series system - CNB. [on-line]  
Available at: <[http://www.cnb.cz/cnb/STAT.ARADY\\_PKG.STROM\\_DRILL?p\\_strid=0&p\\_lang=CS](http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS)>  
[Accessed on 26/11/2013].

The resulting conclusion from the model experiment is, according to the data from Figure 6, obvious: In the long run, the regulatory potential of the discount rate in the definition range of positive numbers is exhausted in the given case after three discount rate growth-decrease cycles. The only option how to apply the discount rate as a rate that controls the commercial rate is to take into account the negative values of the discount rate.

This conclusion is in remarkable consistency with the current situation - the discount rate is virtually zero. The same applies to the REPO rate, sometimes considered as an alternative tool for controlling commercial rates.

## 4 Conclusions

The conclusions we have reached in this paper are undoubtedly alarming.

They quite clearly exceed the horizon of the famous "storms in a glass of water" that may have applied to a small group of banking system management theorists, or a small group of highly privileged "banking sector captains".

The introduction of negative interest rates may be, to a certain extent, acceptable to the world of high finance, especially to its sub-group that can financially positively balance even with real economic drops, even at the level of drops of the national economy as a whole. Which in itself is a crazy possibility, completely beyond any morality. Except for business morality, of course.

Under no circumstances, however, would negative interest rates be acceptable to the population. Here, on the contrary, with a probability bordering on certainty, citizens would perceive negative interest rates as a punishment. As an absurd punishment, since it would be a punishment for depositing (through savings deposited in commercial banks) their temporarily available funds into the national economy. Which would quite certainly (in this case, all illusions must be put aside) shake up the trust of the citizens in the system. Actually, with easily predicted impacts - even a "man in the street" is financially literate enough to find a satisfactory investment alternative (Greenspan, 2008). It is difficult to precisely determine the impacts of these activities on the stability of the domestic financial system. However, they appear to be scary to the author of this paper.

They can be compared with a one-off loss of approximately CZK 600-800 billion associated with the transformation of the Czech economy into a market economy or about CZK 600 billion "leaving" the Czech economy every year due to excessively unilaterally effective considerations which led to the apparent sell-out of the domestic industrial base.

This is the moment when the game is over. The moment when "financial alchemy" (King, 2017), however seductive it appears to be, must end. And that is why this paper seeks to be a modest contribution to the effort to bring both the theoretical discussion and practical action back to the level of common sense.

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